E.G.S. PILLAY ENGINEERING COLLEGE

(Autonomous)

Approved by AICTE, New Delhi | Affiliated to Anna University, Chennai |

Accredited by NAAC with 'A'Grade |Accredited by NBA (CIVIL, CSE, ECE, EEE, IT, MECH)

NAGAPATTINAM – 611 002

B.E Mechanical Engineering

FullTimeCurriculumand Syllabus

Third Year – Sixth Semester

CourseCode	CourseName	L	T	P	C	Maximum Marks		
						CA	ES	Total
Theory Course								
1902ME601	Materials science and Metallurgy	3	0	0	3	40	60	100
1902ME602	Design of Transmission systems	3	2	0	4	40	60	100
1902ME603	Dynamics of Machines	3	2	0	4	40	60	100
1903ME018 1903ME015	PC ElectiveII (Gas dynamics and jet propulsion / Refrigeration and air-conditioning)	3	0	0	3	40	60	100
1901MGX01	HSSElective1 (Total Quality Management)	3	0	0	3	40	60	100
1903ME028	Open ElectiveI (Renewable energy sources)	3	0	0	3	40	60	100
LaboratoryCourse								
1902ME651	Theoryof MachinesLaboratory	0	0	2	1	50	50	100
1904ME652	Mini project (Design and fabrication Project)	0	0	4	2	50	50	100
1904ME653	IndustrialVisit Presentation	0	0	0	1	100	-	100
1904GE651	LifeSkills:AptitudeII	0	0	2	1	100	-	100

L–Lecture|T–Tutorial|P–Practical|CA–ContinuousAssessment| ES –EndSemester

1902ME601	**MATERIALS SCIENCEANDMETALLURGY**	L	T	P	C
		3	**0**	**0**	**3**

MODULE I PHASE DIAGRAMS AND CONSTITUTION OF ALLOYS   **9 Hours**

Alloys,Solidsolutions-Phasediagram,phaserule,leverrule,Binaryphasediagram-Isomorphous,eutectic, peritectic, eutectoid reactions - Iron-Carbon phasediagram -Metallography,microstructure.

MODULE II   ENGINEERING METALS AND ALLOYS   **9 Hours**

ClassificationofEngineeringmaterials-Ferrousmetals-Plaincarbonsteel (low,medium andhighcarbon steels),microstructure/composition,properties,applications-Alloysteels,effectofalloyingadditionsonsteels -stainlesssteels, HighStrengthLowAlloy Steels(HSLA),maraging,toolsteels-Castiron-grey,white, malleable,spheroidalgraphitecastiron,microstructure,properties,applications– Non-ferrousmetals- Nickel, Copper, Titanium, Aluminium, Magnesium, Zinc alloys,properties and applications- Bearing materials.

MODULE III   HEAT TREATMENT OF STEELS   **9 Hours**

Purposeofheattreatment-Annealing(stressrelief,recrystallization,spheroidizing)-Normalizing-Hardening andTempering,Isothermaltransformationdiagrams(T-T-Tdiagrams),CoolingcurvessuperimposedonT-T-T diagrams(martensiteandbainitephaseformation)-Hardenability,Jominy endquenchtest,Casehardening processes, carburizing, nitriding, carbontiriding, cyaniding, flame hardening, induction hardening.

MODULE IV INTRODUCTION TO POLYMERS AND ENGINEERING CERAMICS   **9 Hours**

Polymers- Plasticsandelastomers- Thermoplastsandthermosets,propertiesandapplications(polyethylene, polypropylene,polyurethane,polystyrene,polyvinylchloride,polymethylmethacrylate,polyethyleneterapthalate, polycarbonate, polyamide, acrylonitrilebutadiene styrene, polyamide, polyamideimide, polypropyleneoxide,polypropylenesulphide,polyetheretherketone, polytetrafluroethylene,ureaformaldehyde, phenol formaldehyde, polyester, nylon, epoxy)– Rubberand its types-Types of Ceramics and applications.

MODULE V MECHANICAL PROPERTIES AND MATERIALS TESTING   **9 Hours**

Elasticandplasticdeformation,slipandtwinning- Tensiletest,stress-strainbehaviorofductileandbrittlematerials- Stress-strain behaviour ofelastomers- Viscoelasticity- Compressiontest–Hardnessandtestingmethods-Impact test-Fatiguetest,Stressvsnumberofcycles(S-N)curve,endurancelimit,factorsaffecting fatigue -Creep test, creep curves-Types of fracture - Fracture toughness– Three crack propagation modes.

FOR FURTHERREADING– SEMINAR– CPS   **Total: 45 Hours**

     Review on Super alloys, Shape memory alloys, Composite Materials, Case studies inMetallurgical failure analysis.

Reference(s)

1. WilliamDCallisterJr., Materials Science andEngineering:An Introduction, 7thEdition,JohnWiley &Sons Inc., New York, 2007.
2. G.E.Dieter, MechanicalMetallurgy, McGrawHill, 2007.
3. V.Raghavan,Materials Science andEngineering,PrenticeHallofIndia, Delhi,2009.
4. WilliamSmith and Javed Hashemi, Foundations of Materials Science and Engineering, 5th Edition, McGrawHill, NewYork,2009.
5. G. Murray, C. White and W.Weise, Introduction to Engineering Materials, 2ndEdition, Chemical RubberCompany(CRC)Press, Taylor &Francis Group, Florida, 2007.
6. https://onlinecourses.nptel.ac.in/noc18_mm05/preview

1902ME602	DESIGN OF TRANSMISSIONSYSTEMS	L	T	P	C
		3	2	0	4

12 Hours

MODULE I DESIGN OF FLEXIBLE ELEMENTS

Design of Flatbeltsandpulleys-Selection of Vbeltsandpulleys–Selectionofhoistingwireropesandpulleys–Design ofTransmission chains and Sprockets.

MODULE II SPUR GEARS AND PARALLELAXIS HELICALGEARS   **12 Hours**

Speedratiosandnumberofteeth-Forceanalysis-Toothstresses-   Dynamiceffects–Fatiguestrength-Factorofsafety-Gearmaterials–Designofstraighttoothspur&helicalgearsbasedonstrengthandwearconsiderations–Pressure angle in the normaland transverse plane-Equivalentnumberof teeth-forces for helicalgears

MODULE III BEVEL,WORM AND CROSS HELICALGEARS   **12 Hours**

Straightbevelgear:Tooth terminology, tooth forcesandstresses, equivalentnumberof teeth. Estimatingthe dimensions ofpairofstraightbevelgears.Worm   Gear:Meritsanddemerits-terminology.Thermalcapacity,materials-forcesand stresses,efficiency,estimatingthesizeofthewormgearpair.Crosshelical:Terminology-helixangles-Estimatingthe size of the pair of crosshelicalgears.

MODULE IV GEARBOXES   **12 Hours**

Geometric progression -Standard step ratio- Raydiagram, kinematicslayout-Design of slidingmesh gearbox- Design ofmultispeedgearboxformachinetoolapplications-Constantmeshgearbox-   Speedreducerunit.–   Variablespeedgearbohx, Fluid Couplings,TorqueConvertersfor automotive applications.

MODULE V CAMS,CLUTCHES AND BRAKES   **12 Hours**

Cam   Design: Types-pressureangleandundercuttingbasecircledetermination-forcesandsurfacestresses.   Designof plateclutches–axialclutches-coneclutches-internalexpandingrim clutches-Electromagneticclutches.BandandBlock brakes - externalshoe brakes– Internalexpanding shoe brake.

FOR FURTHER READING   TOTAL:60Hours
Design of MachineTool4Structures:Functions of Machine Tool Structures and their Requirements, Design for Strength,

Reference(s)
1. BhandariV, "DesignofMachine Elements", 3rdEdition, Tata McGraw-HillBookCo, 2010.
2. JosephShigley, Charles Mischke,RichardBudynas and Keith Nisbett"MechanicalEngineeringDesign", 8th Edition, Tata McGraw-Hill, 2008.
3.Prabhu. T.J., "Design ofTransmission Elements", ManiOffset, Chennai, 2000.
4. C.S.Sharma, KamleshPurohit, "Designof Machine Elements", PrenticeHallof India, Pvt. Ltd., 2003.
5. BernardHamrock, Steven Schmid, BoJacobson, "Fundamentals ofMachine Elements", 2nd Edition, Tata McGraw-HillBookCo., 2006.
6. http://nptel.ac.in/courses/108102047/

1902ME603	DYNAMICS OFMACHINES	L	T	P	C
		3	2	0	4

MODULE I DYNAMICFORCEANALYSIS OF MECHANISMS   12 Hours

Principleofsuperposition,Conditionfordynamicanalysis,Dynamicanalysisoffourbar&slider crank mechanism - Engine force analysis.Turning moment diagram for steam &IC Engine. Energy stored in flywheel, Dimensionofflywheel rim,Flywheelin punchingpress.

MODULE II BALANCING   12 Hours

Introduction-Staticbalancinganddynamicbalancing,BalancingofRotatingmassseveralmassesinsameanddifferentplane.BalancingofreciprocatingmassSwayingcouple,Tractive force, HammerBlow. Balancingof coupled locomotives.

MODULE III GOVERNORANDGYROSCOPE   12 Hours

GovernorTerminology, workingprinciple,Types- Watt,PorterandProellgovernor,CharacteristicsofGovernor-sensitiveness,Hunting,Ichoronisn,Stability.Gyroscope- Gyroscopiceffect,gyroscopiccouple, gyroscopic effecton aeroplanesand navalships.

MODULE IV FUNDAMENTAL OF VIBRATION   12 Hours
Introduction-Terminology, Classification, elements of vibration, free undampedvibration, Free Damped vibration(ViscusDamping)- Dampingratioandlogarithmicdecrement.Forcedampedvibration- Magnification factor. Vibration isolation and transmissibility.

MODULE V TRANSVERSEANDTORSIONAL VIBRATION   12 Hours
Transverse vibration of shafts and beams Shaft carrying several loads, whirling of shafts. Torsional vibration-effectofinertiaontorsionalvibration-TorsionallyequivalentShaft,singlerotor,tworotorsandthree rotors system.

                 TOTAL 45Hours

Reference(s)

1. Uicker,J.J.,PennockG.RandShigley, J.E., "TheoryofMachines and Mechanisms" ,3rd Edition, OxfordUniversityPress, 2009.
2. Rattan, S.S, "Theoryof Machines", 3rdEdition, TataMcGraw-Hill, 2009
3. Thomas Bevan, "Theoryof Machines", 3rd Edition, CBSPublishers andDistributors, 2005.
4. 2. Cleghorn.W. L, "Mechanisms ofMachines", OxfordUniversityPress, 2005
5. 3. BensonH.Tongue, "Principles of Vibrations",OxfordUniversityPress, 2ndEdition, 2007
6. http://nptel.ac.in/12106166.

		L	T	P	C
1902ME651	**THEORY OF MACHINES LABORATORY**	**0**	**0**	**2**	**1**

EXPERIMENT1

Determination of massmomentof inertia ofaxisymmetric bodies using turntable apparatus

EXPERIMENT2

Determine the characteristics and effortofWatt,PorterProellandHartnellGovernors

EXPERIMENT3

Exercise onBalancing of reciprocating masses.

EXPERIMENT4

Exercise onBalancing of four rotating masses placed on differentplane.

EXPERIMENT5

Analyze the gyroscopic effectusing Gyroscope and verifyits laws.

EXPERIMENT6

Determination of criticalspeed ofshaft with concentrated loads byWhirling of shaft&vibration table apparatus.

EXPERIMENT7

Determine the momentofinertia ofobjectbyBifilarsuspension, Trifilar&method of oscillation.

EXPERIMENT8

Kinematic analysis ofcam model, Epicycle gear train anddifferentialmodel.

EXPERIMENT9

Determination ofnatural frequencyofsingle degreeoffreedomsystem&two rotor system

EXPERIMENT10

Determine the frequencyof forced vibration using Cantileverbeam.

EXPERIMENT11

Determination ofnatural frequencyofTorquemeasurementsystem.

Total: 30 Hours

1904ME652	MINIPROJECT	L	T	P	C
	(Design and fabricationProject)	0	0	4	2

GUIDELINEFORREVIEW ANDEVALUATION

Thestudentsmaybegroupedinto2to 4 andworkunderaprojectsupervisor.Thedevice/system/component(s) tobefabricatedmay bedecidedinconsultationwiththesupervisorandifpossiblewithanindustry.Aproject reporttobesubmitted by thegroupandthefabricatedmodel,whichwillbereviewedandevaluatedforinternal assessmentbyaCommitteeconstitutedby theHeadoftheDepartment.Attheendofthe semester examination theprojectworkis evaluatedbasedonoralpresentation andtheprojectreportjointly by externalandinternal examiners constituted bytheHeadof theDepartment

Total: 60 Hours

1904ME653   **INDUSTRIALVISIT PRESENTATION**   **L   T   P   C**
                                                                                          0   0   0   1

GUIDELINEFORREVIEW ANDEVALUATION

In order to provide the experiential learning to the students, shall take efforts to arrange at leastone industrialvisit/field visits in a year. Apresentation based on Industrialvisits shallbemade in this semesterand suitable creditmaybe awarded bythe Committee constituted bythe Head of theDepartment at the end of the semesterexamination

1904GE651	**LIFESKILLS: APTITUDE– II**	L	T	P	C
		0	0	2	1

MODULE I   **PARTNERSHIP, MIXTURES AND ALLEGATIONS, PROBLEM ON**   **6 Hours**
AGES, SIMPLE INTEREST, COMPOUND INTEREST

Introduction Partnership - Relation between capitals, Period of investments and Shares- Problems on mixtures - Allegation rule- Problems on Allegation–Problems on ages-Definitions Simple Interest- Problems on interest and amount- Problems when rate of interest and time period are numerically equal- Definition and formula for amount in compound interest- Difference between simple interest and compound interest for 2 years on the same principle and time period.

MODULE II   **BLOOD RELATIONS, CLOCKS, CALENDARS**   **6 Hours**

Defining the various relations among the members of a family- Solving Blood Relation puzzles-Solving the problems on Blood Relations using symbols and notations-Finding the angle when the time is given- Finding the time when the angle is known-Relation between Angle, Minutes and Hours - Exceptional cases in clocks - Definition of a Leap Year - Finding the number of Odd days- Framing the year code for centuries - Finding the day of any random calendar date .

MODULE III   **TIME AND DISTANCE, TIME AND WORK**   **6 Hours**

Relation between speed, distance and time- Converting kmph in to m/s and vice versa-Problems on average speed- Problems on relative speed-Problems on trains-Problems on boats and streams-Problems on circular tracks- Problems on races- Problems on Unitary method-Relation between Men, Days, Hours and Work- Problems on Man- Day-Hours method -Problems on alternate days-Problems on Pipes and Cisterns

MODULE IV   **DATA INTERPRETATION AND DATA SUFFICIENCY**   **6 Hours**

Problems on tabular form-Problems on Line Graphs- Problems on Bar Graphs- Problems on Pie Charts- Different models in Data Sufficiency- Problems on data redundancy

MODULE V   **ANALYTICAL AND CRITICAL REASONING**   **6 Hours**

Problems on Linear arrangement-Problems on Circular arrangement- Problems on Double line-up- Problems on Selections-Problems on Comparisons-Finding the Implications for compound statements-Finding the Negations for compound statements- Problems on assumption- Problems on conclusions- Problems on inferences- Problems on strengthening and weakening of arguments

TOTAL   30 Hours

1903ME018   **GAS DYNAMICS AND JET PROPULSION**   **L T P C**
3 0 0 3

UNIT I   BASIC CONCEPTS AND ISENTROPIC FLOW   9
Energy and momentum equations of compressible fluid flows – Stagnation states, Mach waves and Mach cone – Effect of Mach number on compressibility – Isentropic flow through variable ducts – Nozzle and Diffusers

UNIT II   FLOW THROUGH DUCTS   9
Flows through constant area ducts with heat transfer (Rayleigh flow) and Friction (Fanno flow) – variation of flow properties.

UNIT III   NORMAL AND OBLIQUE SHOCKS   9
Governing equations – Variation of flow parameters across the normal and oblique shocks – Prandtl – Meyer relations – Applications.

UNIT IV   JET PROPULSION   9
Theory of jet propulsion – Thrust equation – Thrust power and propulsive efficiency – Operating principle, cycle analysis and use of stagnation state performance of ram jet, turbojet, turbofan and turbo prop engines.

UNIT V   SPACE PROPULSION   9
Types of rocket engines – Propellants-feeding systems – Ignition and combustion – Theory of rocket propulsion – Performance study – Staging – Terminal and characteristic velocity – Applications – space flights.

FOR FURTHER READING   Total   45 Hours
        Case Study: Advanced Aircraft Engines, select Fuel for Air-craft engines.
Reference(s)
1. Patrick H. Oosthuizen and William E. Carscallen, Introduction to Compressible Fluid Flow, 2nd edition, CRC Press, Taylor & Francis Group, Florida,2014.
2. Robert D. Zucker, Fundamentals of Gas Dynamics, 2nd edition, John Wiley & Sons Inc., New York,2002.
3. George P. Sutton and Oscar Biblarz, Rocket Propulsion Elements, 9th edition, John Wiley &Sons Inc., New York,2016.
4. S. M. Yahya, Fundamentals of Compressible Flow with Aircraft and Rocket Propulsion, 6th edition, New Age International private Limited,2018.

1903ME028	RENEWABLE ENERGY SOURCES	L	T	P	C
		3	0	0	3

Course Objectives

☐ To learn about solar radiation and solar thermal system application.
☐To provide knowledge on fundamentals and sizing of solar photovoltaics.
☐ To study about the potential andenergy conversion process of Wind Energy and Bio Energy.
☐ To impart fundamental knowledge about Ocean Thermal Energy and Geothermal Energy.
☐ To provide knowledge about the recent trends in Hydrogen and Fuel Cells.

9 Hours

UNIT I   INTRODUCTION

World Energy Use – Reserves of Energy Resources – Environmental Aspects of Energy Utilisation –Renewable Energy Scenario in Tamil nadu, India and around the World – Potentials - Achievements /Applications – Economics of renewable energy systems.

UNIT II   SOLAR ENERGY   9 Hours

Solar Radiation – Measurements of Solar Radiation - Flat Plate and Concentrating Collectors – Solardirect Thermal Applications – Solar thermal Power Generation - Fundamentals of Solar Photo VoltaicConversion – Solar Cells – Solar PV Power Generation – Solar PV Applications.

UNIT III   WIND ENERGY   9 Hours

Wind Data and Energy Estimation – Types of Wind Energy Systems – Performance – Site Selection –Details of Wind Turbine Generator – Safety and Environmental Aspects

UNIT IV   BIO – ENERGY   9 Hours

Biomass direct combustion – Biomass gasifiers – Biogas plants – Digesters – Ethanol production –Bio diesel – Cogeneration - Biomass Applications

UNIT V   OTHER RENEWABLE ENERGY SOURCES   9 Hours

Tidal energy – Wave Energy – Open and Closed OTEC Cycles – Small Hydro-Geothermal Energy –Hydrogen and Storage - Fuel Cell Systems – Hybrid Systems.

FOR FURTHER READING – SEMINAR – CBS   Total: 45 Hours

Solar pond ,types of pvpanels,Thermal energy storage materials, Renewable energy harvesting by nanomaterials

Reference(s)

1. Rai. G.D., "Non Conventional Energy Sources", Khanna Publishers, New Delhi, 2018.
2. Twidell, J.W. & Weir, A.,"Renewable Energy Sources", EFN Spon Ltd., UK, second edition
3. Boyle, Godfrey. 2004. "Renewable Energy (2nd edition)". Oxford University Press, 450 pages (ISBN: 0-19- 926178-4).
4. J A Duffie and W A Beckman"Solar Engineering of Thermal Processes" 3rdedition
5. Sukhatme, Suhas P., and J. K. Nayak. "Solar energy",McGraw-Hill Education, 2017.
6. https://onlinecourses.nptel.ac.in/noc19_ge11/course